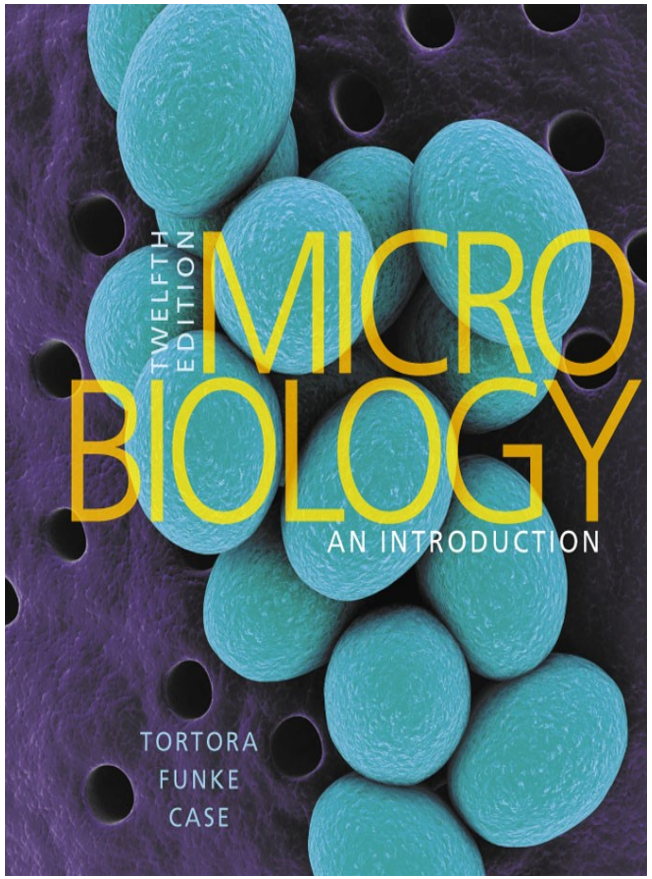
Microbiology an Introduction

Twelfth Edition



Chapter 21

Microbial Diseases of the Skin and Eyes

Pearson

Staphylococcus Aureus

Structure and Function of the Skin (1 of 3)

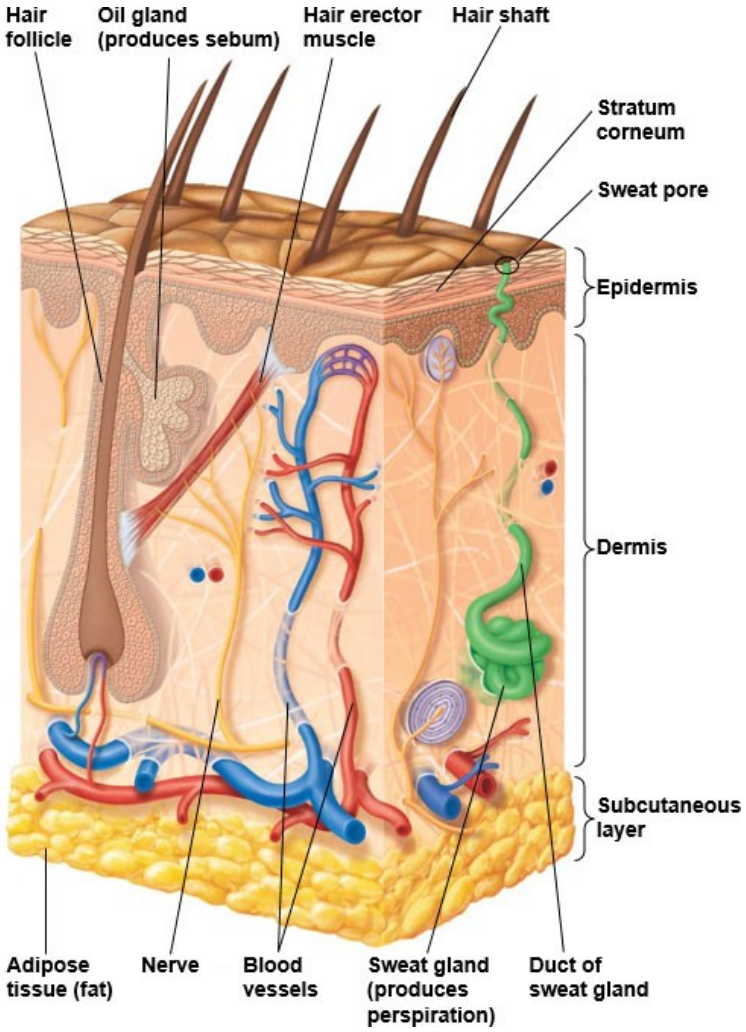
Learning Objective

21-1 Describe the structure of the skin and mucous membranes and the ways pathogens can invade the skin.

Structure and Function of the Skin (2 of 3)

- **Epidermis:** thin outer portion of skin; composed of layers of epithelial cells
- **Keratin:** waterproofing protein coating outer layer of epidermis
- **Dermis:** inner, thick portion of skin; composed mainly of connective tissue

Figure 21.1 The Structure of Human Skin



Pearson

Structure and Function of the Skin (3 of 3)

- Perspiration provides moisture and nutrients for growth
  - Contains salt that inhibits microorganisms
- Lysozyme breaks down bacterial cell walls
- Antimicrobial peptides
- Sebum secreted by oil glands contains fatty acids that inhibit pathogens

Mucous Membranes (1 of 2)

- Line the body cavities open to the exterior
- Tightly packed epithelial cells attached to an extracellular matrix
  - Cells secrete mucus
  - Some cells have cilia
- Often acidic
- Membrane of eyes washed by tears containing lysozyme
- Often folded to maximize surface area

Check Your Understanding-1

Check Your Understanding

- ✓ Moisture in perspiration encourages microbial growth. What perspiration factors discourage growth?
  21-1

Normal Microbiota of the Skin (1 of 3)

Learning Objective

21-2 Provide examples of normal skin microbiota, and state the general locations and ecological roles of its members.

Normal Microbiota of the Skin (2 of 3)

- Resistant to drying and high salt concentration
- Large numbers of gram-positive cocci
  - Staphylococci
  - Micrococci
- Areas with moisture have higher populations
  - Metabolize sweat and contribute to body odor

Normal Microbiota of the Skin (3 of 3)

- Gram-positive pleomorphic rods (diphtheroids)
  - **Propionibacterium acnes** inhabits hair follicles; anaerobic
    - Produce acids that maintain low skin pH
  - **Corynebacterium xerosis** occupy the skin surface; aerobic
- Yeast
  - **Malassezia furfur;** causes dandruff

Check Your Understanding-2

Check Your Understanding

- ✓ Are skin bacteria more likely to be gram-positive or gram-negative?
  21-2

Microbial Diseases of the Skin (1 of 4)

Learning Objectives

21-3 Differentiate staphylococci from streptococci, and name several skin infections caused by each.

21-4 List the causative agent, mode of transmission, and clinical symptoms of **Pseudomonas** dermatitis, otitis externa, acne, and Buruli ulcer.

Microbial Diseases of the Skin (2 of 4)

Learning Objective

21-5 List the causative agents, modes of transmission, and symptoms of warts, smallpox, monkeypox, chickenpox, shingles, cold sores, measles, rubella, fifth disease, hand-foot-mouth disease, and roseola.

Microbial Diseases of the Skin (3 of 4)

Learning Objectives

21-6 Differentiate cutaneous from subcutaneous mycoses and provide an example of each.

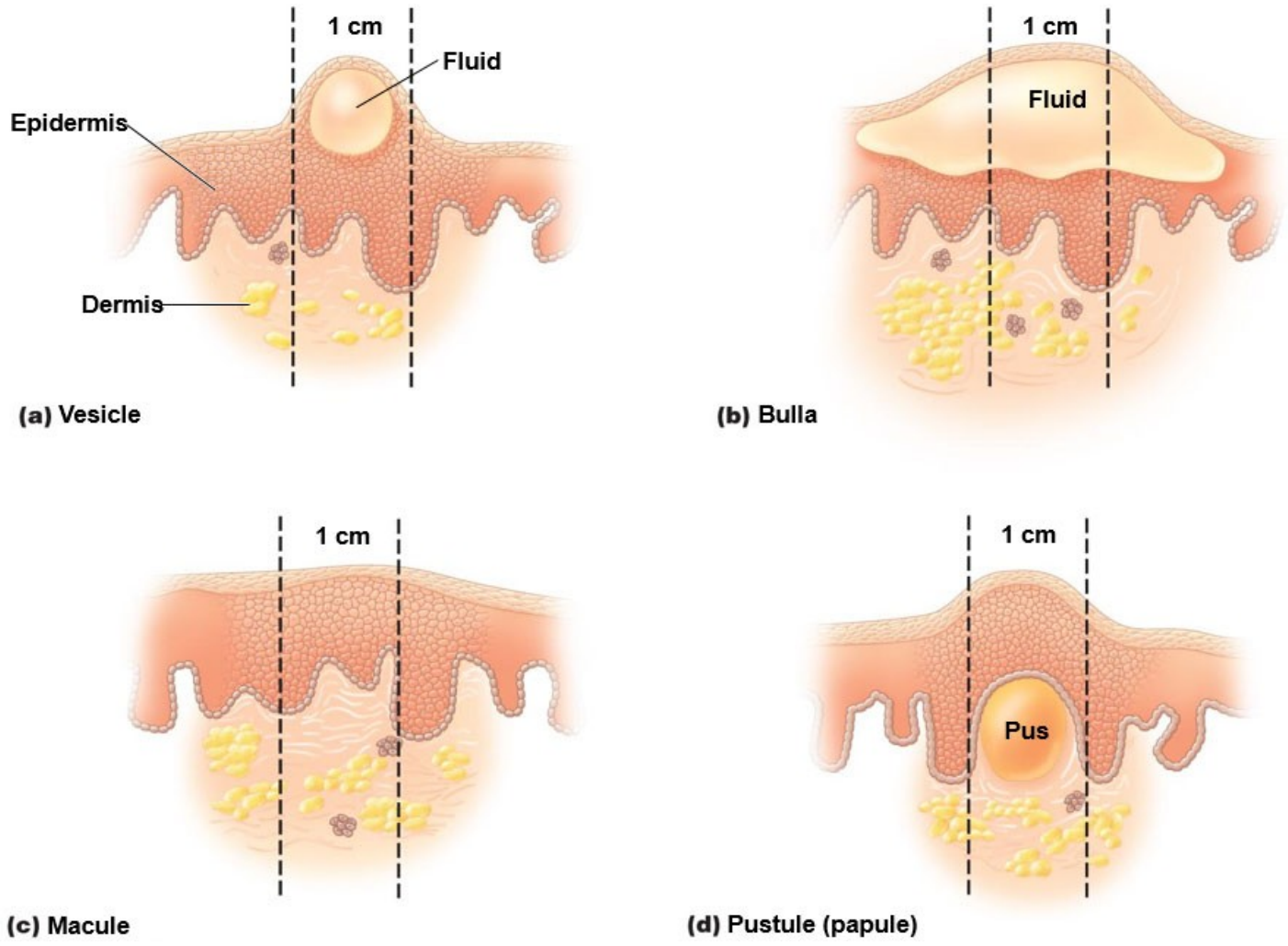
21-7 List the causative agent and predisposing factors for candidiasis.

21-8 List the causative agent, mode of transmission, clinical symptoms, and treatment for scabies and pediculosis.

Microbial Diseases of the Skin (4 of 4)

- **Vesicles:** small, fluid-filled lesions
- **Bullae:** vesicles larger than 1 cm in diameter
- **Macules:** flat, reddened lesions
- **Papules:** raised lesions
- **Pustules:** raised lesions with pus
- **Exanthem:** skin rash arising from a disease
- **Enanthem:** rash on mucous membranes arising from a disease

Figure 21.2 Skin Lesions

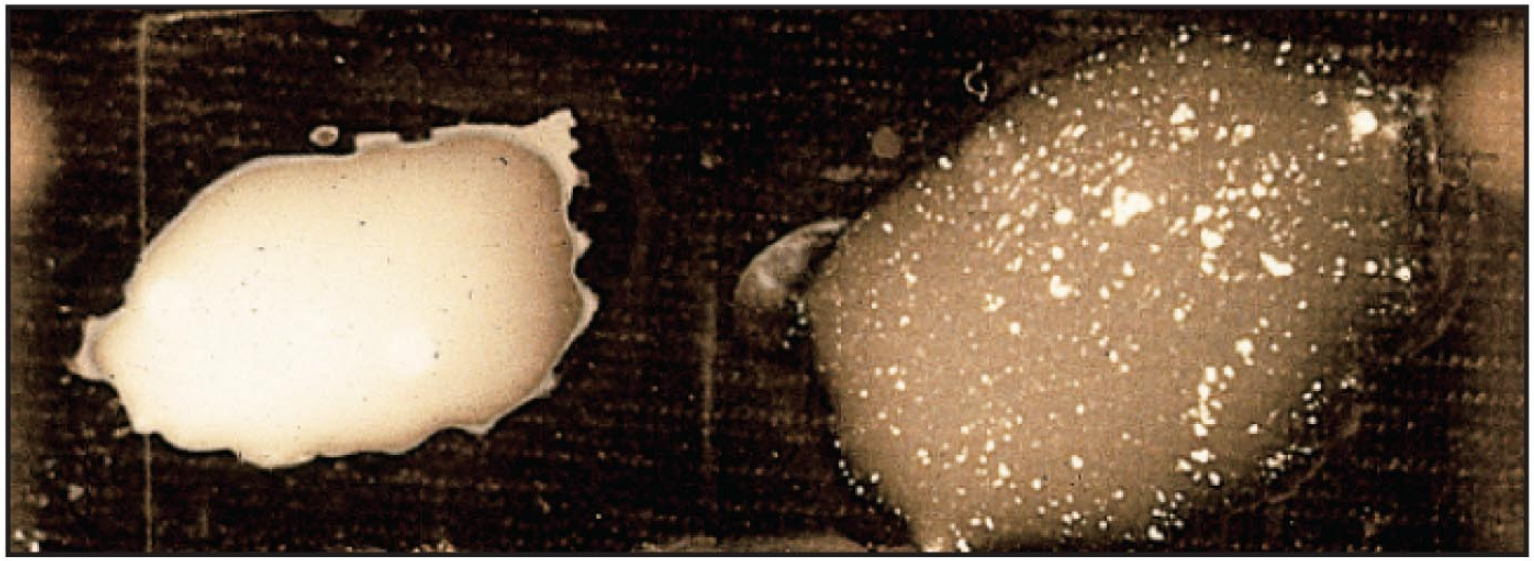


Pearson

Staphylococcal Skin Infections
(1 of 8)

- Staphylococci
  - Spherical gram-positive bacteria; form irregular clusters
  - Many produce **coagulase**
    - Enzyme that clots fibrin in the blood
    - Used to identify types of staphylococci

Clinical Focus 21.1b

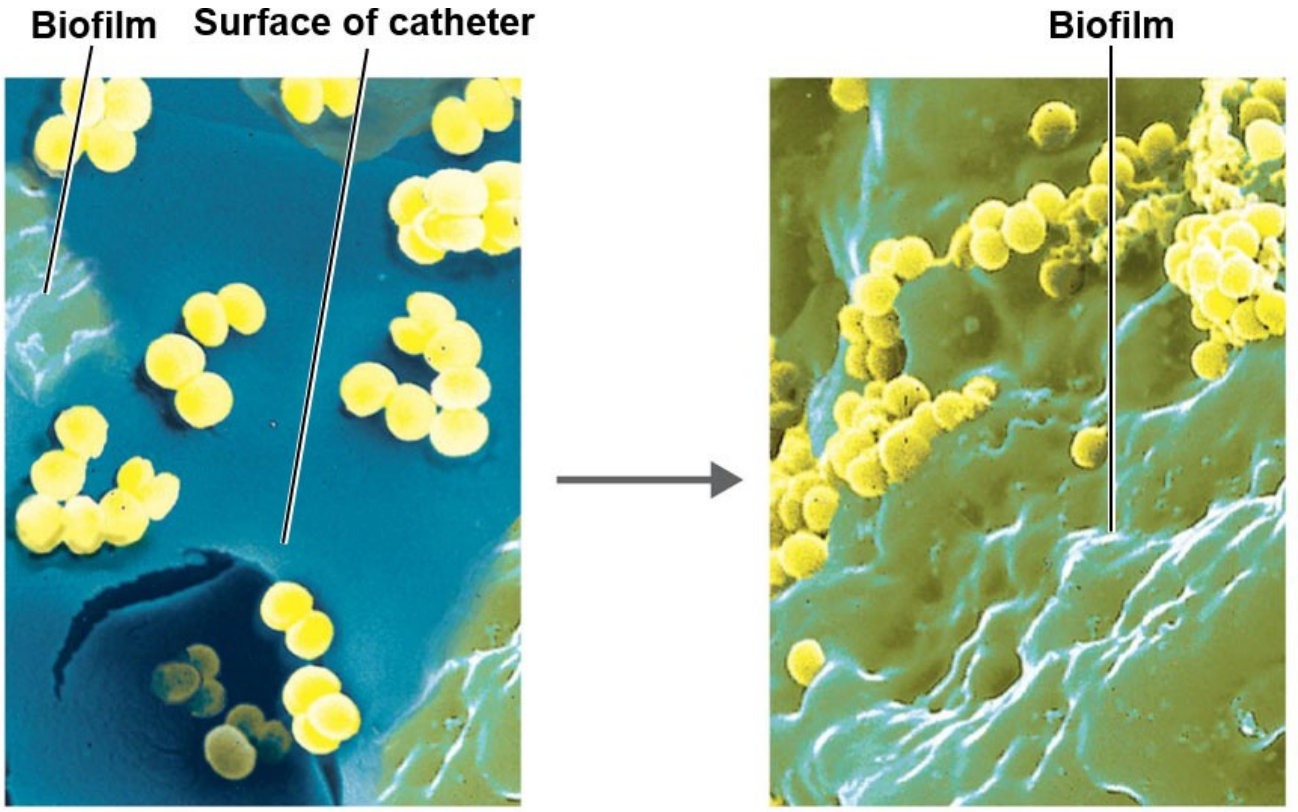


Negative control Isolate from patient

Staphylococcal Skin Infections
(2 of 8)

- **Staphylococcus epidermidis**
  - Ninety percent of normal skin microbiota
  - Healthcare-associated pathogen
  - Produces biofilm on catheters
  - Coagulase-negative

Figure 21.3 Coagulase-Negative Staphylococci



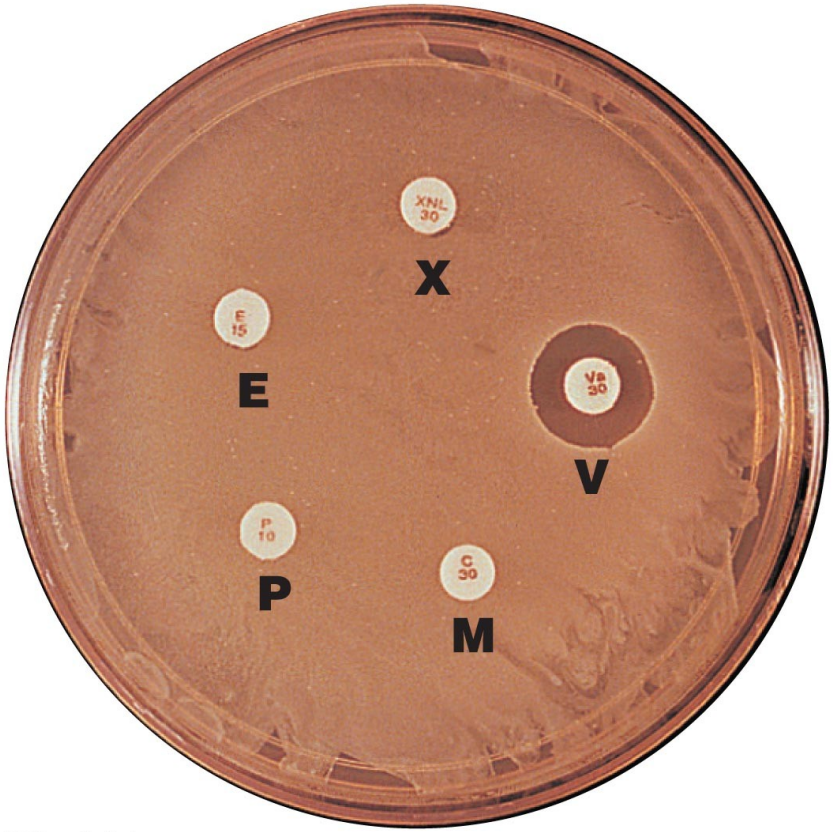
(a) Catheter surface with adhering bacteria. Biofilm, light green, is beginning to appear.

(b) Most of the bacteria producing the slime are not visible under the biofilm.

Staphylococcal Skin Infections
(3 of 8)

- **Staphylococcus aureus**
  - Carried in the nasal passages of 20% of the population
  - Golden-yellow colonies
  - Coagulase-positive
  - May produce damaging toxins and cause sepsis
  - Avoids host defenses in the skin
    - Secretes proteins and toxins that kill phagocytic cells
  - MRSA strains are antibiotic-resistant

Clinical Focus 21.1c



Staphylococcal Skin Infections
(4 of 8)

- **Folliculitis:** infections of the hair follicles
- **Sty:** folliculitis of an eyelash
- **Furuncle (boil):** a type of **abscess;** localized region of pus surrounded by inflamed tissue
- **Carbuncle:** damage and inflammation of deep tissue from a spreading furuncle
- **Impetigo:** crusting (nonbullous) sores, spread by autoinoculation

Figure 21.4 Lesions of Impetigo

Staphylococcal Skin Infections
(5 of 8)

- **Scalded skin syndrome**
  - Bullous impetigo
  - Toxin B causes exfoliation
  - **Pemphigus neonatorum:** impetigo of the newborn
- **Toxic shock syndrome (TSS)**
  - Fever, vomiting, shock, and organ failure caused by toxic shock syndrome toxin 1 (TSST-1) in the bloodstream

Figure 21.5 Lesions of Scalded Skin Syndrome

Diseases in Focus: Macular Rashes

- A 4-year-old boy with a history of cough, conjunctivitis, and fever (38.3°C) now has a macular rash that started on his face and neck and is spreading to the rest of his body.
- Can you identify infections that could cause these symptoms?

Diseases in Focus 21.1 (1 of 3)

Diseases in Focus 21.1 (2 of 3)

Disease	Pathogen	Portal of Entry	Symptoms	Method of Transmission	Treatment
VIRAL DISEASES. Usually diagnosed by clinical signs and symptoms and may be confirmed by serology or PCR.					
Measles (rubeola)	Measles virus	Respiratory tract	Reddish macules first appearing on face and spreading to trunk and extremities	Aerosol	No treatment; preexposure vaccine
Rubella (German measles)	Rubella virus	Respiratory tract	Mild disease with a macular rash resembling measles, but less extensive and disappearing in 3 days or less	Aerosol	No treatment; preexposure vaccine
Fifth Disease (erythema infectiosum)	Human parvovirus B19	Respiratory tract	Mild disease with a macular facial rash	Aerosol	None

Diseases in Focus 21.1 (3 of 3)

Disease	Pathogen	Portal of Entry	Symptoms	Method of Transmission	Treatment
Roseola	Human herpesvirus 6, human herpesvirus 7	Respiratory tract	High fever followed by macular body rash	Aerosol	None
Hand-Foot-and-Mouth Disease	Enteroviruses	Mouth	Flat or raised rash	Aerosol; direct contact	None
FUNGAL DISEASE. Confirmed by Gram staining of skin scrapings.					
Candidiasis	**Candida albicans**	Skin; mucous membranes	Macular rash	Direct contact; endogenous infection	Miconazole, clotrimazole (topically)

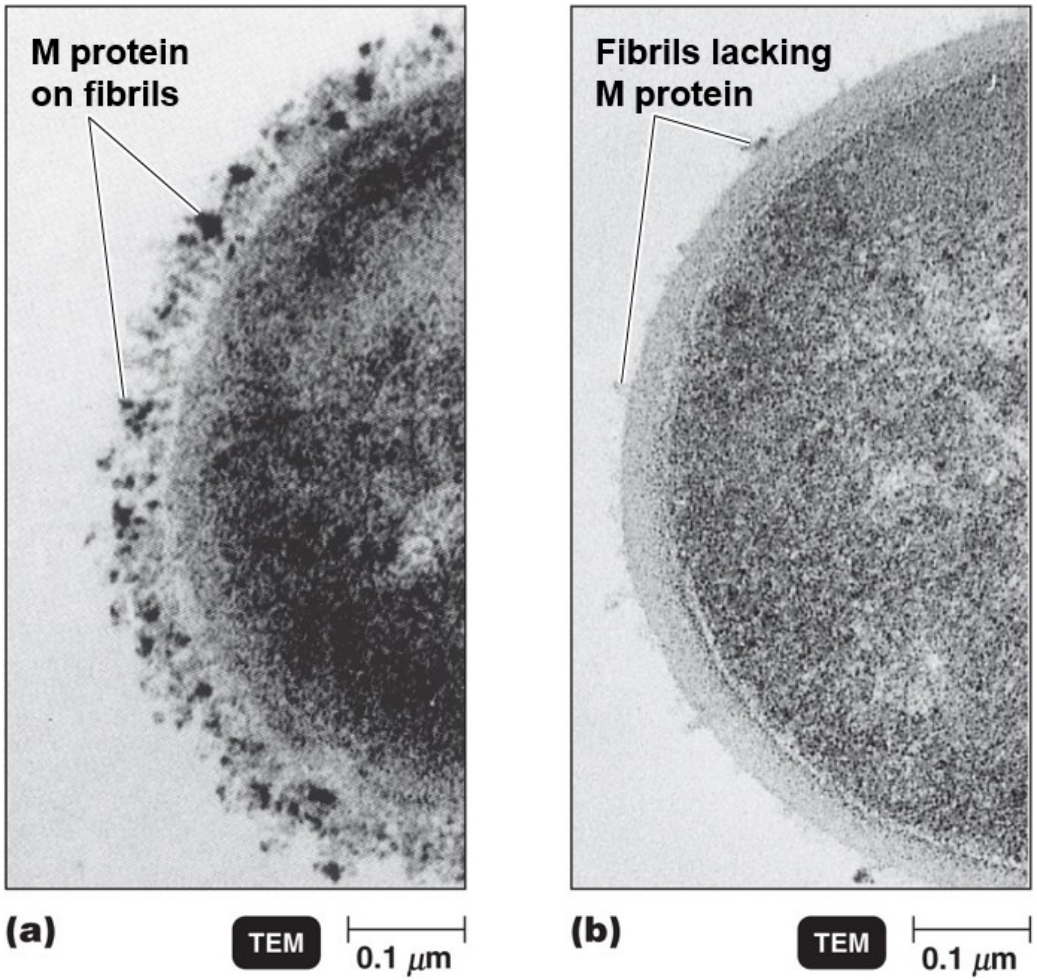
Staphylococcal Skin Infections
(6 of 8)

- Gram-positive cocci in chains
- Produce hemolysins that lyse red blood cells
- Beta-hemolytic streptococci often cause disease
  - Streptococci differentiated into groups A through T based on antigenic cell wall carbohydrates

Staphylococcal Skin Infections
(7 of 8)

- **Group A streptococci (GAS),** also known as **Streptococcus pyogenes**
  - Eighty immunological types
  - Produce virulence factors
    - Streptolysins: lyse RBCs
    - M proteins: external to the cell wall; allow adherence and immune system avoidance
    - Hyaluronidase: dissolves connective tissue
    - Streptokinases: dissolve blood clots

Figure 21.6 The M Protein of Group A Beta-Hemolytic Streptococci



Staphylococcal Skin Infections
(8 of 8)

- **Erysipelas**
  - **S. pyogenes** infects the dermal layer of the skin
    - Causes local tissue destruction and sepsis
- **Necrotizing fasciitis**
  - "Flesh-eating" disease
  - Extotoxin A produced by **S. pyogenes** acts as a superantigen
- Streptococcal toxic shock syndrome
  - Similar to staphylococcal TSS

Figure 21.7 Lesions of Erysipelas, Caused by Group a Betahemolytic Streptococcal Toxins

Figure 21.8 Necrotizing Fasciitis Due to Group A Streptococci

Infections by Pseudomonads

- **Pseudomonas aeruginosa**
  - Gram-negative, aerobic rod
  - **Pyocyanin** produces a blue-green pus
  - Produces exo- and endotoxins; grows in biofilms
  - **Pseudomonas dermatitis**
    - Self-limiting rash acquired in swimming pools
  - **Otitis externa**
    - "Swimmer's ear"
  - Opportunistic in burn patients
  - Resistant to many antibiotics

Buruli Ulcer

- Caused by **Mycobacterium ulcerans**
  - Produces the toxin **mycolactone**
- Enters via a break in the skin or an insect bite
- Causes deep, damaging ulcers
  - May require amputation
- Exceeds incidence of leprosy
  - Primarily found in western and central Africa

Acne (1 of 2)

- Most common skin disease in humans
- Skin cells shed in the hair follicles and combine with sebum
  - Causes blockages
- Sebum formation is affected by hormones, not diet
- **Comedonal (mild) acne**
  - Easily treated with topical formations

Acne (2 of 2)

- **Inflammatory (moderate) acne**
  - Caused by **Propionibacterium acnes**
    - Metabolizes sebum; fatty acids produce an inflammatory response
  - Treated with antibiotics and benzoyl peroxide
- **Nodular cystic (severe) acne**
  - Inflamed lesions with pus deep in the skin

Figure 21.9 Severe Acne

Check Your Understanding-3

Check Your Understanding

- ✓ Which bacterial species features the virulence factor M protein?
  21-3
- ✓ What is the common name for otitis externa?
  21-4

Viral Diseases of the Skin

- Many are transmitted via respiratory routes and are systemic
- Many cause problems in children and developing fetuses

Warts

- Papillomas: small skin growths
- Transmitted via contact
- Caused by **papillomavirus**
  - More than 50 types
  - Some cause skin and cervical cancers
- Treated with cryotherapy, electrodesiccation, or salicylic acid

Smallpox (Variola) (1 of 2)

- Caused by an orthropoxvirus
- Two forms of the disease
  - **Variola major** has 20% mortality
  - **Variola minor** has < 1% mortality
- Transmitted via the respiratory route, moves into the bloodstream, and infects the skin
- Completely eradicated from the human population by vaccination
- Potential bioterrorism agent

Smallpox (Variola) (2 of 2)

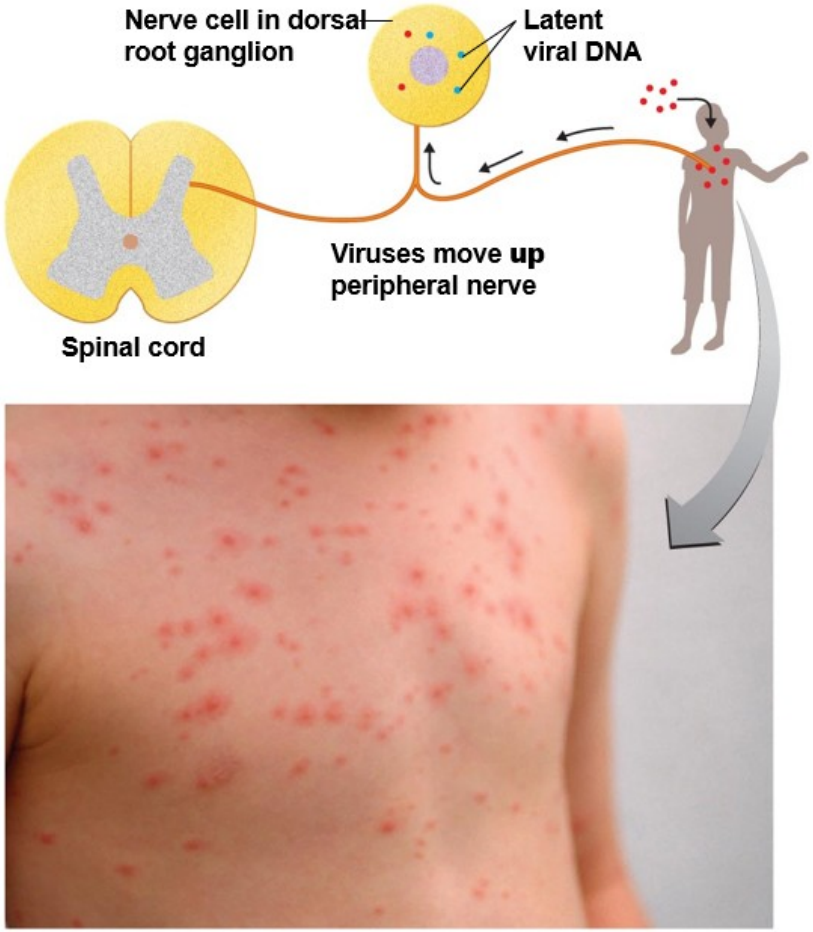
- **Monkeypox**
  - Related to smallpox
  - Endemic to small animals in Africa
  - Jumps from animals to humans
  - Mortality of 1–10%
  - Prevention by the smallpox vaccination

Figure 21.10 Smallpox Lesions

Chickenpox (Varicella) and Shingles (Herpes Zoster) (1 of 2)

- **Chickenpox (varicella)**
  - Herpesvirus varicella-zoster (human herpesvirus 3)
  - Transmitted via the respiratory route
  - Causes pus-filled vesicles
  - **Reye's syndrome:** severe complications of chickenpox; vomiting and brain dysfunction
    - Aspirin use increases risk
  - Virus becomes latent in the central nerve ganglia
  - Prevented by a live attenuated vaccine
    - **Breakthrough varicella** can occur if previously vaccinated

Figure 21.11a Chickenpox (Varicella) and Shingles (Herpes Zoster)

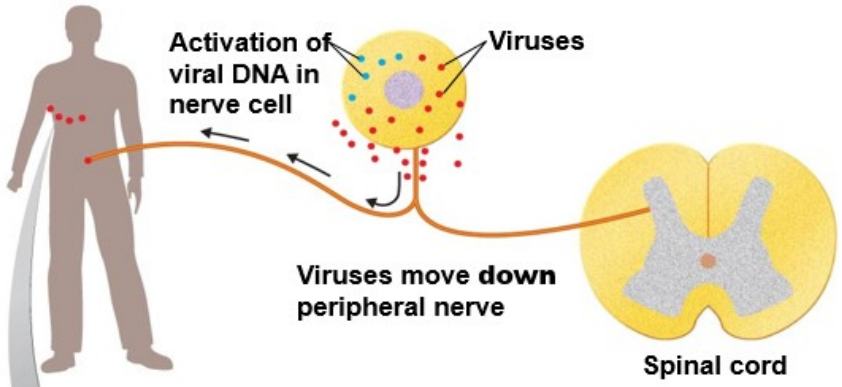


(a) Initial infection: chickenpox (varicella)

Chickenpox (Varicella) and Shingles (Herpes Zoster) (2 of 2)

- **Shingles** (herpes zoster)
  - Reactivation of the latent varicella-zoster virus that moves along peripheral nerves to the skin
    - Due to stress or lowered immunity
  - Follows the distribution of affected cutaneous sensory nerves
    - Limited to one side of the body
  - Postherpetic neuralgia
  - Prevention via the zoster vaccine
  - Antiviral drugs may lessen symptoms

Figure 21.11b Chickenpox (Varicella) and Shingles (Herpes Zoster)



(b) Recurrence of infection: shingles (herpes zoster)

Herpes Simplex (1 of 2)

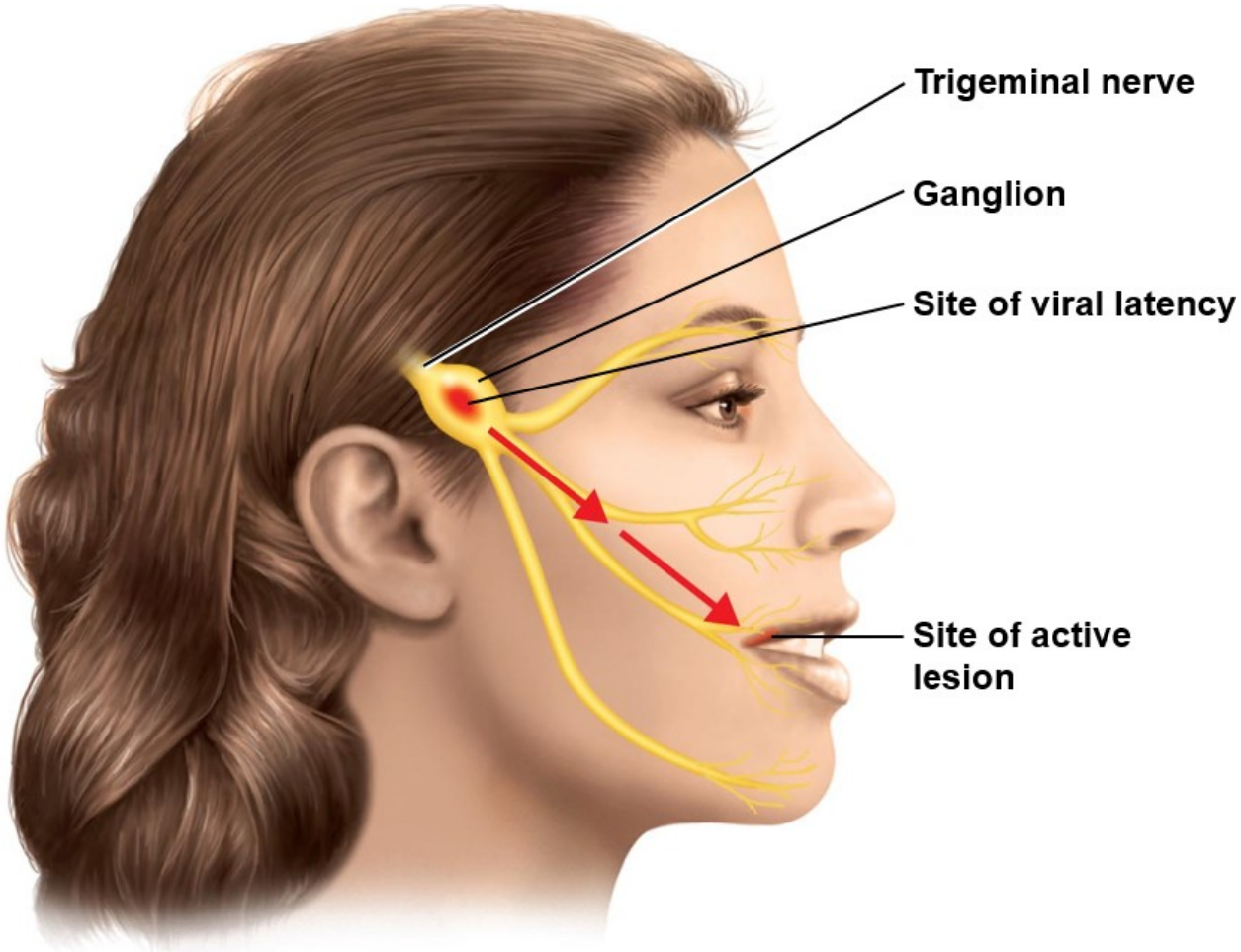
- Human herpesvirus 1 (HSV-1) and 2 (HSV-2)
  - HSV-1 is spread primarily by oral or respiratory routes
  - HSV-2 is spread primarily sexually
- Ninety percent of the population is infected
- Usually develop as **cold sores** or **fever blisters**
  - Not the cause of canker sores

Figure 21.12 Cold Sores, or Fever Blisters, Caused by Herpes Simplex Virus

Herpes Simplex (2 of 2)

- HSV-1 remains latent in trigeminal nerve ganglia
  - Outbreaks are triggered by the sun, stress, or hormonal changes
- HSV-2 remains latent in sacral nerve ganglia near the spine
- **Herpes gladiatorum:** vesicles on the skin
- **Herpetic whitlow:** vesicles on the fingers
- **Herpes encephalitis:** virus spreads to the brain
  - Treated with acyclovir

Figure 21.13 Site of Latency of Herpes Simplex Type 1 in the Trigeminal Nerve Ganglion



Measles (Rubeola)

- Viral disease transmitted by the respiratory route
- Cold-like symptoms, macular rash
- Koplik's spots
  - Red spots on the oral mucosa opposite the molars
- Encephalitis in 1 in 1000 cases
- **Subacute sclerosing panencephalitis**
  - Rare; occurs 1 to 10 years after measles recovery
- Prevented by the MMR (measles, mumps, rubella) vaccine

Figure 21.14 The Rash of Small Raised Spots Typical of Measles (Rubeola)

Rubella

- German measles
- Rubella virus
- Macular rash and light fever
- Transmitted via the respiratory route; 2 to 3 week incubation
- **Congenital rubella syndrome**
  - Fetal damage, deafness, heart defects, mental retardation
  - Fifteen percent mortality
- Prevented by the MMR vaccine
  - Not recommended for pregnant women

Figure 21.15 The Rash of Red Spots Characteristic of Rubella

Other Viral Rashes

- **Fifth disease (erythema infectiosum)**
  - Human parvovirus B19
  - Mild flulike symptoms; "slapped-cheek" facial rash
- **Roseola**
  - Human herpesviruses 6 and 7
  - High fever; body rash; recovery within 1 to 2 days
- Hand-foot-mouth disease
  - Enteroviruses
  - Spread via mucous or saliva (usually children)
  - Fever and sore throat; rash on the hands, feet, mouth, and tongue

Diseases in Focus: Vesicular and Pustular Rashes

- An 8-year-old boy has a rash consisting of vesicular lesions of 5 days' duration on his neck and stomach. Within 5 days, 73 students in his elementary school have an illness matching the case definition for this disease.
- Can you identify infections that could cause these symptoms?

Diseases in Focus 21.2 (1 of 3)

Diseases in Focus 21.2 (2 of 3)

Disease	Pathogen	Portal of Entry	Symptoms	Method of Transmission	Treatment
Impetigo	**Staphylococcus aureus**	Skin	Vesicles on skin	Direct contact; fomites	Topical antibiotics
VIRAL DISEASES. Usually diagnosed by clinical signs and symptoms and may be confirmed by serology or PCR.					
Smallpox (variola)	Smallpox (variola) virus	Respiratory tract	Pustules that may be nearly confluent on skin	Aerosol	None
Monkeypox	Monkeypox virus	Respiratory tract	Pustules, similar to smallpox	Direct contact with or aerosols from infected small mammals	None

Diseases in Focus 21.2 (3 of 3)

Disease	Pathogen	Portal of Entry	Symptoms	Method of Transmission	Treatment
Chickenpox (varicella)	Varicella-zoster virus	Respiratory tract	Vesicles in most cases confined to face, throat, and trunk	Aerosol	Acyclovir for immunocompromised patients; preexposure vaccine
Shingles (herpes-zoster)	Varicella-zoster virus	Endogenous * infection of Peripheral Nerves	Vesicles typically on one side of waist, face and scalp, or upper chest	Recurrence of latent chickenpox infection	Acyclovir; preventive vaccine
Herpes Simplex	Herpes simplex virus type 1	Skin; mucous Membranes	Vesicles around mouth; can also affect other areas of skin and Mucous membranes	Initial infection by direct contact; recurring latent Infection	Acyclovir

*Endogenous infections are infections caused by microorganisms already part of the host microbiota.

Check Your Understanding-4

Check Your Understanding

- ✓ How did the odd naming of "fifth disease" arise? 21-5

Fungal Diseases of the Skin and Nails (1 of 2)

- **Mycosis:** fungal infection of the body
- Cutaneous mycoses
  - Colonize the hair, nails, and outer epidermis
  - Metabolize keratin
  - **Dermatomycoses**
    - Informally known as **tineas** or **ringworm**
    - **Tinea capitis:** scalp ringworm
    - **Tinea cruris:** jock itch
    - **Tinea pedis:** athlete's foot
    - **Tinea unguium:** ringworm of nails

Fungal Diseases of the Skin and Nails (2 of 2)

- Cutaneous mycoses
  - Genera of fungi involved:
    - **Trichophyton**
    - **Microsporum**
    - **Epidermophyton**
  - Treatment is usually topical drugs (miconazole and clotrimazole)

Figure 21.16 Dermatomycoses

(a) Ringworm (Tinea barbae)

(b) Athlete's foot (Tinea pedis)

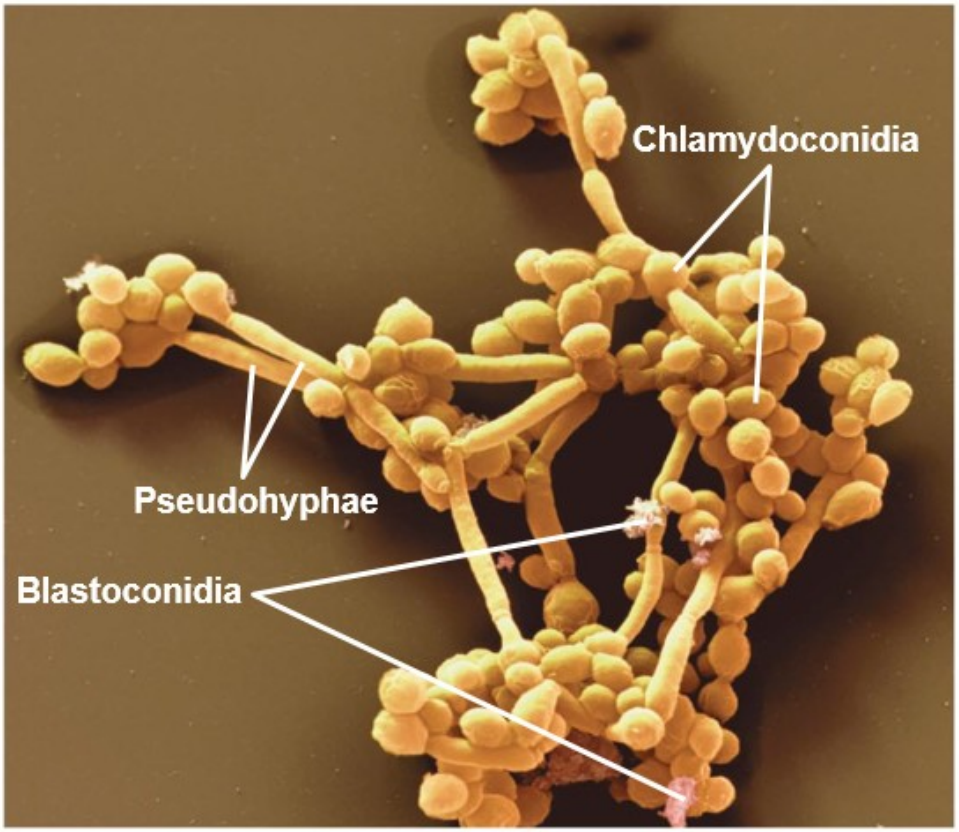
Subcutaneous Mycoses

- More serious than cutaneous mycoses
- Penetrate the stratum corneum
- Usually caused by fungi that inhabit the soil
- **Sporotrichosis**
  - Caused by **Sporothrix schenkii;** dimorphic fungus
  - Enters a wound; forms a small ulcer
  - Treated with potassium iodide

Candidiasis

- Overgrowth of **Candida albicans** (yeast)
  - Forms pseudohyphae, making it resistant to phagocytosis
- Occurs in the skin and mucous membranes of the genitourinary tract and mouth
  - **Thrush: C. albicans** infection of the oral cavity
- Results when antibiotics suppress competing bacteria or a change occurs in the mucosal pH
- Fulminating disease in the immunosuppressed

Figure 21.17 Candidiasis



(a) *Candida albicans*

(b) Oral candidiasis, or thrush

Check Your Understanding-5

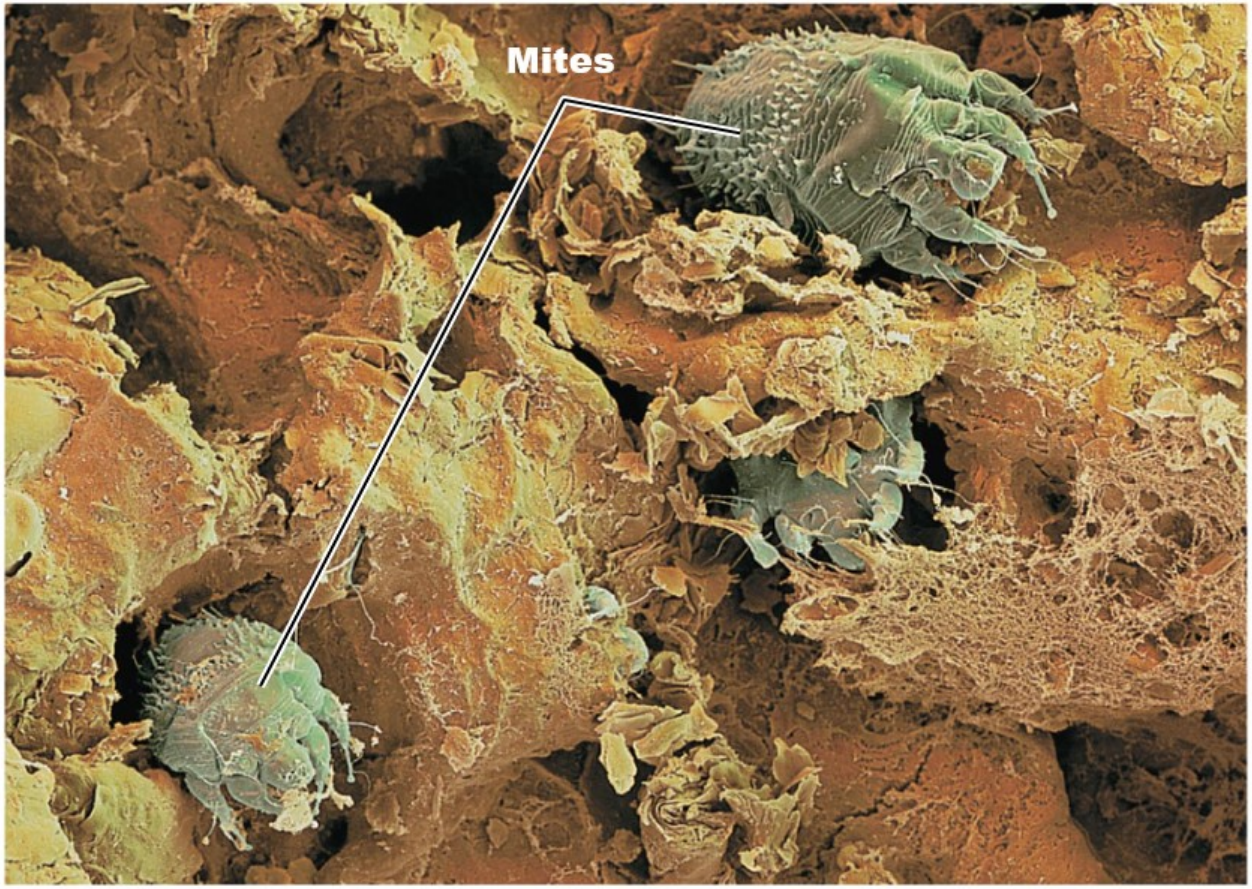
Check Your Understanding

- ✓ How do sporotrichosis and tineas differ? How are they similar?
  21-6
- ✓ How might penicillin use result in candidiasis?
  21-7

Scabies

- Caused by **Sarcoptes scabiei** mites
  - Burrow in the skin to lay eggs
- Causes inflammatory skin lesions
- Transmitted via intimate contact
- Treatment with permethrin

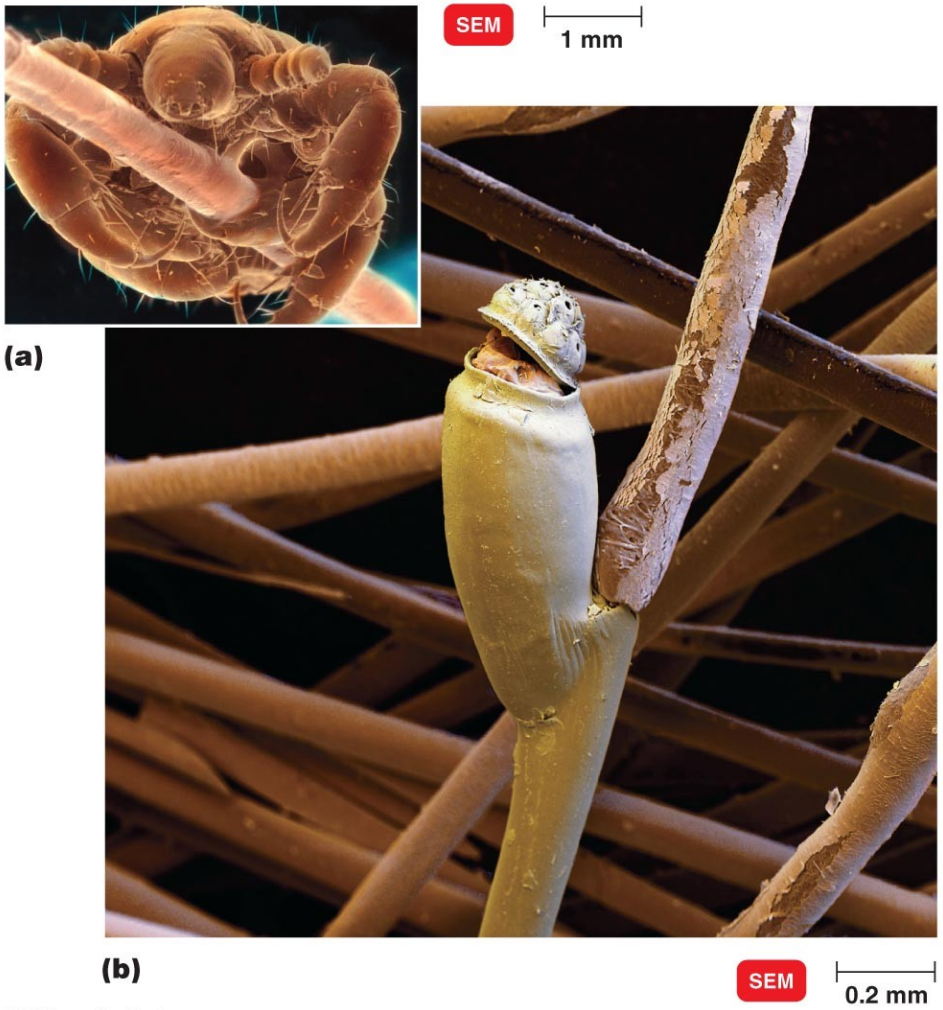
Figure 21.18 Scabies Mites in Skin



Pediculosis (Lice)

- **Pediculus humanus capitis** (head louse)
- **P. h. corporis** (body louse)
- Feed on blood from the host
- Lay eggs (nits) on the hair and attach to the shafts
- Treatment with topical insecticides (permethrin or pyrethrin)
  - Malathion, lindane, or ivermectin are used in cases of resistance

Figure 21.19 Louse and Louse Egg Case



Diseases in Focus: Patchy Redness and Pimplelike Conditions

- An 11-month-old boy comes to a clinic with a 1-week history of an itchy red rash under his arms. The rash seems to bother him more at night and he has no fever.
- Can you identify infections that could cause these symptoms?

Diseases in Focus 21.3 (1 of 5)

Diseases in Focus 21.3 (2 of 5)

Disease	Pathogen	Portal of Entry	Symptoms	Method of Transmission	Treatment
BACTERIAL DISEASES. Usually diagnosed by culturing the bacteria.					
Folliculitis	**Staphylococcus aureus**	Hair follicle	Infection of hair follicle	Direct contact; fomites; endogenous infection*	Draining of pus; topical antibiotics
Toxic Shock Syndrome	**Staphylococcus aureus**	Surgical incisions	Fever, rash, shock	Endogenous infection*	Antibiotics, depending on sensitivity profile (antibiogram)
Necrotizing Fasciitis	**Streptococcus pyogenes**	Skin abrasions	Extensive soft-tissue destruction	Direct contact	Surgical tissue removal; broad-spectrum antibiotics
Erysipelas	**Streptococcus pyogenes**	Skin; mucous membranes	Reddish patches on skin; often with high fever	Endogenous infection*	Cephalosporin
Pseudomonas	**Pseudomonas**	Skin	Superficial	Swimming	Usually self-

Diseases in Focus 21.3 (3 of 5)

Disease	Pathogen	Portal of Entry	Symptoms	Method of Transmission	Treatment
Otitis Externa	**Pseudomonas aeruginosa**	Ear	Superficial infection of external ear canal	Swimming water	Fluoroquinolones
Acne	**Propionibacterium acnes**	Sebum channels	Sebum channels Inflammatory lesions originating with accumulations of sebum that rupture a hair follicle	Direct contact	Benzoyl peroxide, isotretinoin, azelaic acid
Buruli Ulcer	**Mycobacterium ulcerans**	Skin	Localized swelling or hardness progressing to deep ulcer	Contaminated water	Antimycobacterial drugs

Diseases in Focus 21.3 (4 of 5)

Disease	Pathogen	Portal of Entry	Symptoms	Method of Transmission	Treatment
VIRAL DISEASE. Usually diagnosed by clinical signs and symptoms.					
Warts	**Papillomavirus**	Skin	A horny projection of the skin formed by proliferation of cells	Direct contact	Removal by liquid nitrogen cryotherapy, electrodesiccation, acids, lasers
FUNGAL DISEASES. Diagnosis is confirmed by microscopic examination.					
Ringworm (tinea)	**Microsporum, Trichophyton, Epidermophyton**	Skin	Skin lesions of highly varied appearance; on scalp may cause local loss of hair	Direct contact; fomites	Griseofulvin (orally); miconazole, clotrimazole (topically)
Sporotrichosis	**Sporothrix schenkii**	Skin abrasions	Ulcer at site of infection spreading into nearby lymphatic vessels	Soil	Potassium iodide solution (orally)

Diseases in Focus 21.3 (5 of 5)

Disease	Pathogen	Portal of Entry	Symptoms	Method of Transmission	Treatment
PARASITIC INFESTATIONS. Diagnosis is confirmed by microscopic examination of parasite.					
Scabies	**Sarcoptes scabiei (mite)**	Skin	Papules, itching	Direct contact	Gamma benzene hexachloride, permethrin (topically)
Pediculosis (lice)	**Pediculus humanus capitis**	Skin	Itching	Primarily direct contact; possible fomites such as bedding, combs	Topical insecticide preparations

*Endogenous infections are infections caused by microorganisms already part of the host microbiota.

Check Your Understanding-6

Check Your Understanding

- ✓ What diseases, if any, are spread by head lice, such as **Pediculus humanus capitis**?
  21-8

Microbial Diseases of the Eye

Learning Objectives

21-9 Define **conjunctivitis**.

21-10 List the causative agent, mode of transmission, and clinical symptoms of these eye infections: ophthalmia neonatorum, inclusion conjunctivitis, trachoma.

21-11 List the causative agent, mode of transmission, and clinical symptoms of these eye infections: herpetic keratitis, **Acanthamoeba** keratitis.

Inflammation of the Eye Membranes: Conjunctivitis

- An inflammation of the conjunctiva
- Also called **red eye** or **pinkeye**
- Commonly caused by **Haemophilus influenzae**
  - Also caused by adenoviruses
- Can be caused by pseudomonads associated with unsanitary contact lenses

Big Picture: Fungal Keratitis (1 of 2)

- Fungal keratitis
  - Outbreak in 2005–2006 was due to contaminated contact lens solution
  - Caused by **Fusarium spp**. filamentous fungi
    - Form biofilms that form a mat of hyphae on contact lenses
    - Resistant to many antifungal drugs
    - Natamycin: only antifungal approved to treat fungal keratitis

Big Picture: Fungal Keratitis (2 of 2)

The fungus *Fusarium solaris*, a cause of fungal keratitis. Conidiospores are produced from the tips of the hyphae.

The signs of fungal kerititis include a red and painful eye, excessive tearing, and discharge.

Ophthalmia

- Caused by **Neisseria gonorrhoeae**
- Large amount of pus forms; ulceration of corneas results
  - Untreated cases may lead to blindness
- Transmitted to a newborn's eyes during passage through the birth canal
- Prevented by treating a newborn's eyes with antibiotics

Inclusion Conjunctivitis

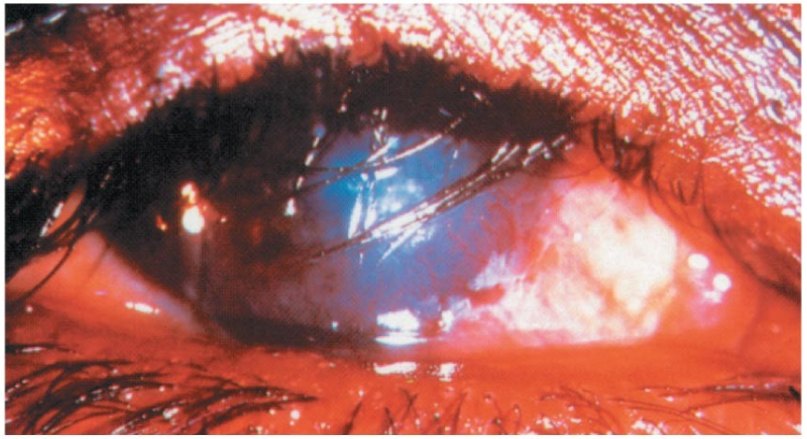
- Caused by **Chlamydia trachomatis**
  - Bacterium that grows as an obligate intracellular parasite
- Transmitted to a newborn's eyes during passage through the birth canal
- Spread through swimming pool water
- Treated with tetracycline

Trachoma

- Caused by some serotypes of **Chlamydia trachomatis**
- Leading cause of blindness worldwide
- Transmitted via hand contact or flies
- Infection causes permanent scarring; scars abrade the cornea, leading to blindness
  - Secondary infections can also be a factor
- Oral azithromycin are used in treatment

Figure 21.20 Trachoma

(a) Chronic inflammation of the eyelid



(b) Trichiasis, inturned eyelashes, abrading the cornea

Check Your Understanding-7

Check Your Understanding

- ✓ What is the common name of inclusion conjunctivitis?
  21-9
- ✓ Why have antibiotics almost entirely replacedthe less expensive use of silver nitrate for preventing ophthalmia neonatorum?
  21-10

Other Infectious Diseases of the Eye (1 of 2)

- Keratitis
  - Inflammation of the cornea
  - Bacterial (United States)
  - **Fusarium** and **Aspergillus** (Africa and Asia)
- **Herpetic keratitis**
  - Caused by herpes simplex virus 1 (HSV-1)
  - Infects cornea and may cause blindness
  - Treated with trifluridine

Other Infectious Diseases of the Eye (2 of 2)

- **Acanthamoeba keratitis**
  - Ameba transmitted via water and soil
  - Associated with unsanitary contact lenses
  - Mild inflammation followed by severe pain
  - Treatment with propamidine isethionate and neomycin
  - May require a corneal transplant

Diseases in Focus: Microbial Diseases of the Eye

- In the morning a 20-year-old man has eye redness with a crust of mucus. The condition resolves with topical antibiotic treatment.
- Can you identify infections that could cause these symptoms?

Diseases in Focus 21.4 (1 of 3)

Diseases in Focus 21.4 (2 of 3)

Disease	Pathogen	Portal of Entry	Symptoms	Method of Transmission	Treatment
BACTERIAL DISEASES					
Conjunctivitis	**Haemophilus influenzae**	Conjunctiva	Redness	Direct contact; fomites	None
Ophthalmia Neonatorum	**Neisseria gonorrhoeae**	Conjunctiva	Acute infection with much pus formation	Through birth canal	Prevention: tetracycline, erythromycin, or povidone-iodine
Inclusion Conjunctivitis	**Chlamydia trachomatis**	Conjunctiva	Swelling of eyelid; mucus and pus Formation	Through birth canal; swimming pools	Tetracycline
Trachoma	**Chlamydia trachomatis**	Conjunctiva	Conjunctivitis	Direct contact; fomites; flies	Azithromycin

Diseases in Focus 21.4 (3 of 3)

Disease	Pathogen	Portal of Entry	Symptoms	Method of Transmission	Treatment
VIRAL DISEASES					
Conjunctivitis	Adenoviruses	Conjunctiva	Redness	Direct contact	None
Herpetic Keratitis	Herpes simplex type 1 virus	Conjunctiva; cornea	Keratitis	Direct contact; recurring latent infection	Trifluridine may be effective
PROTOZOAN DISEASE					
Acanthamoeba Keratitis	**Acanthamoeba** spp.	Corneal abrasion; soft contact lenses may prevent removal of ameba by blinking	Keratitis	Contact with fresh water	Topical propamidine isethionate or miconazole; corneal transplant or eye removal surgery may

Check Your Understanding-8

Check Your Understanding

- ✓ Of the two eye diseases herpetic keratitis and **Acanthamoeba keratitis**, which is the more likely to be caused by an organism actively reproducing in saline solutions for contact lenses? 21-11